

Hard Landing

Daniel Bueno Silveira Lima
Monica Fiumana Martin Falcon

Hard Landing Introduction

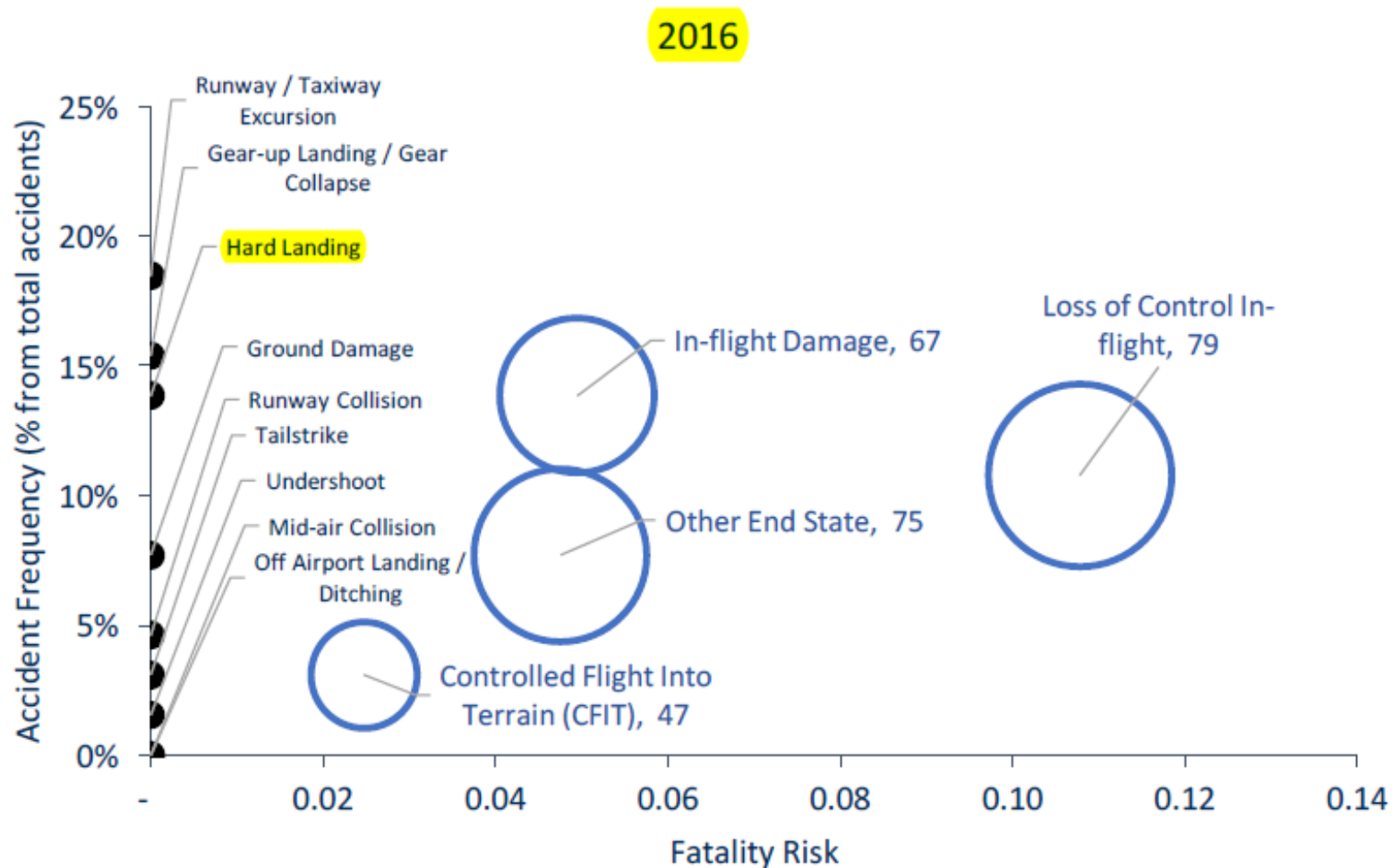
Description: A hard landing is a high energy runway contact.

Under normal conditions, landing-gear load is affected directly by the airplane's **gross weight**. As gross weight increases, the required approach speed increases. By keeping glide path the same, the higher approach speed results in a higher descent rate and, thus, a higher load applied to the landing gear. This load increases with the square of any increasing in the vertical rate of descent.

A smooth touchdown typically is accomplished by extending the flare to allow airspeed to decrease to just above the point of stall. The loss of airspeed during an extended flare, however, can result in a sudden, rapid loss of altitude and a **hard landing**. In some specific conditions, a firm touchdown might be appropriate.



Hard Landing Statistics



IATA Safety Report 2016

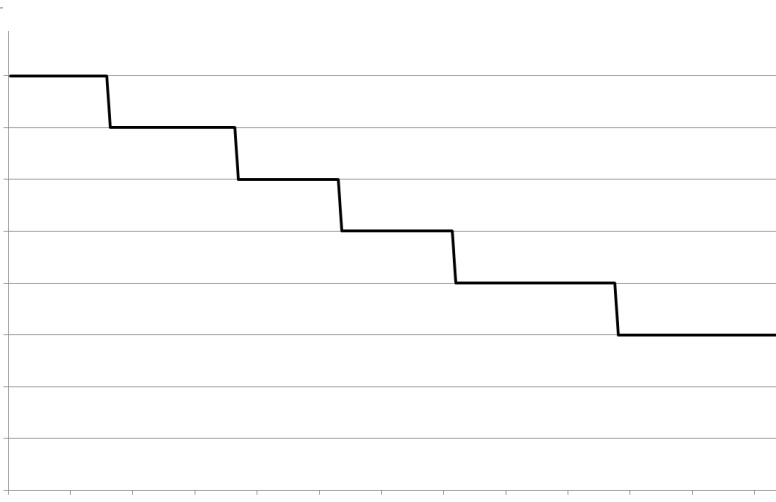


Hard Landing detection

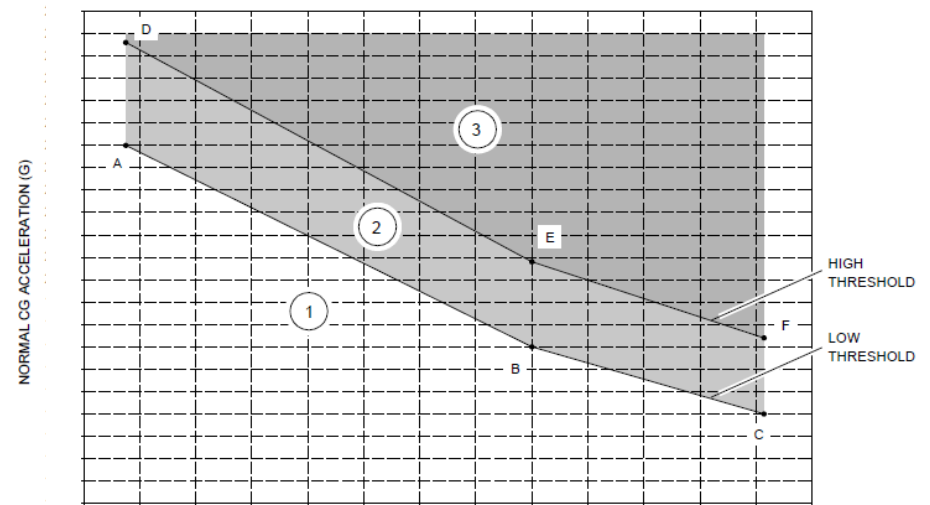
Must be done using AMM, checking:

Vertical acceleration and Roll Rate
Combined with Gross Weight
Pitch Rate

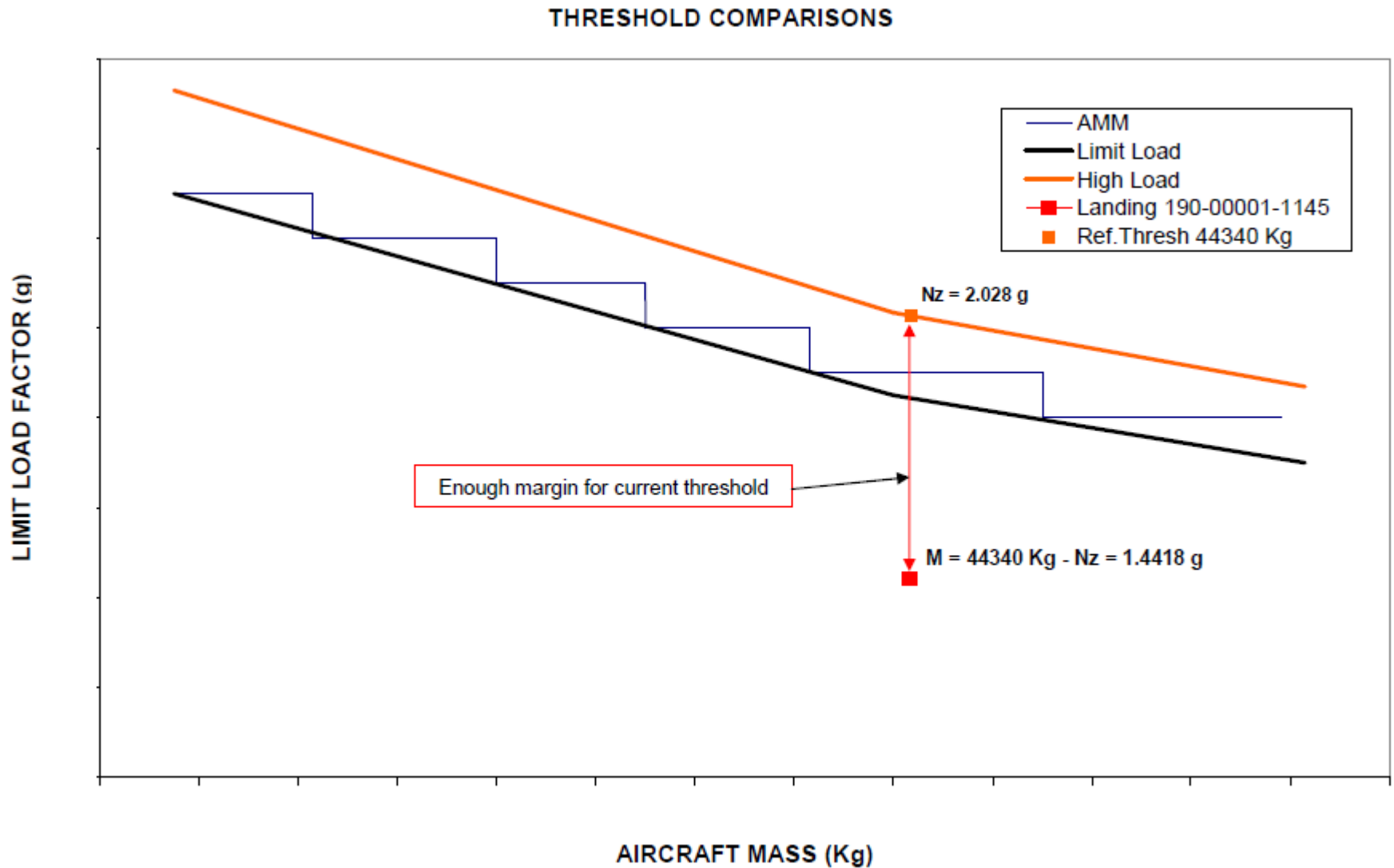
Old AMM



New AMM

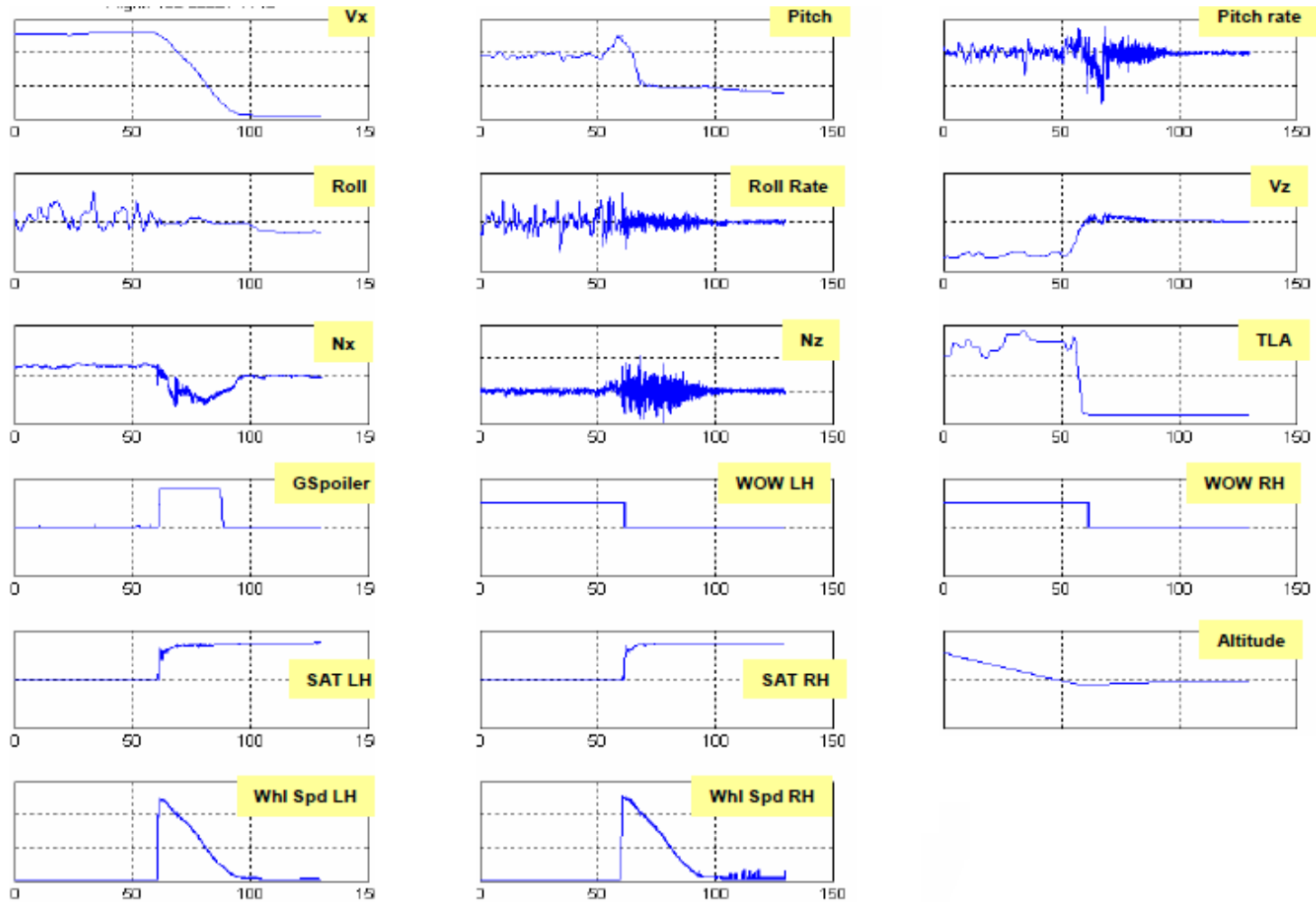


Hard Landing – threshold comparisons

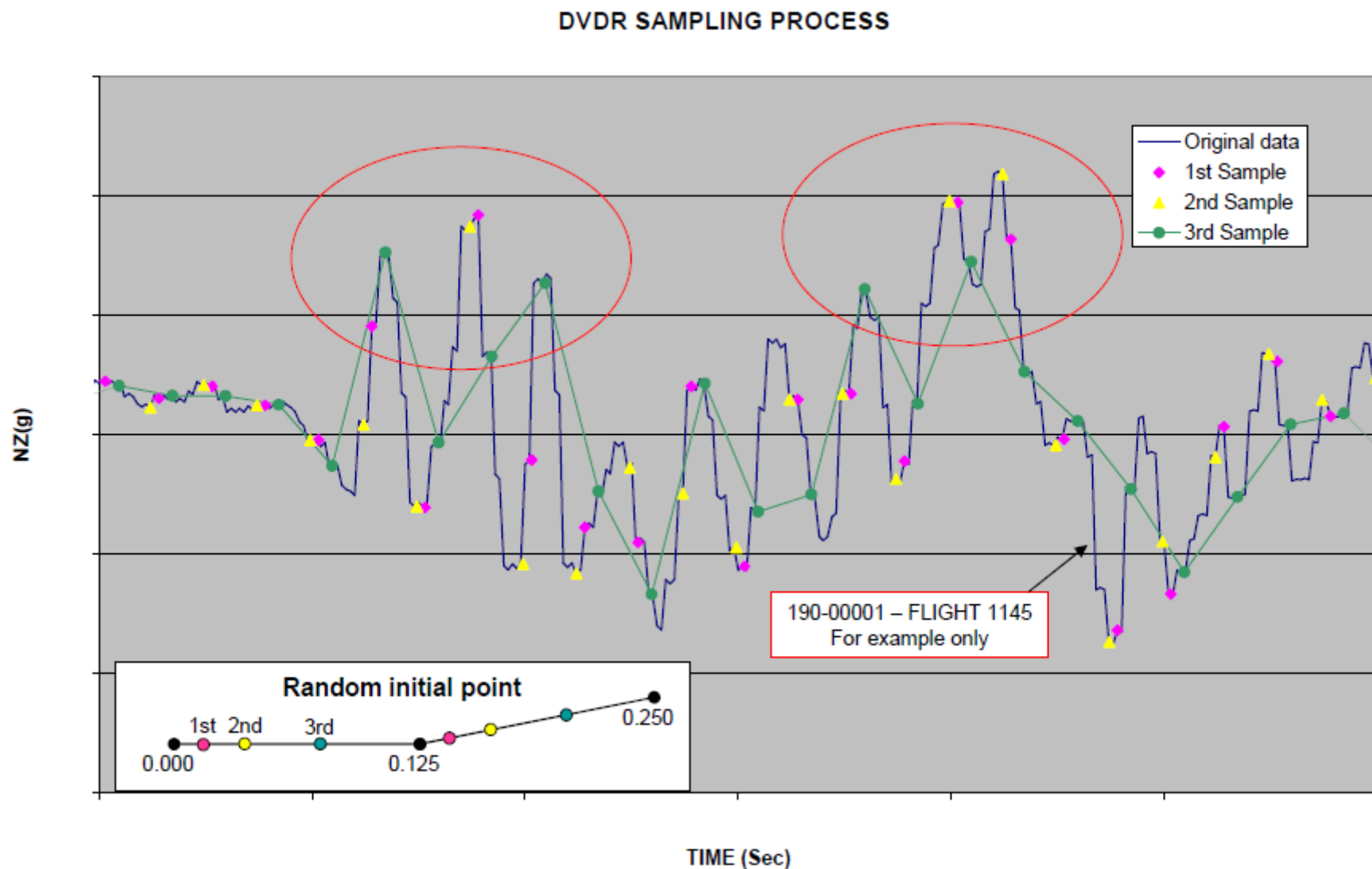


Parameters used on threshold definition process

PROTOTYPE FTI – PARAMETERS AVAILABLE FOR HARD LANDING ANALYSIS AT 100 Hz

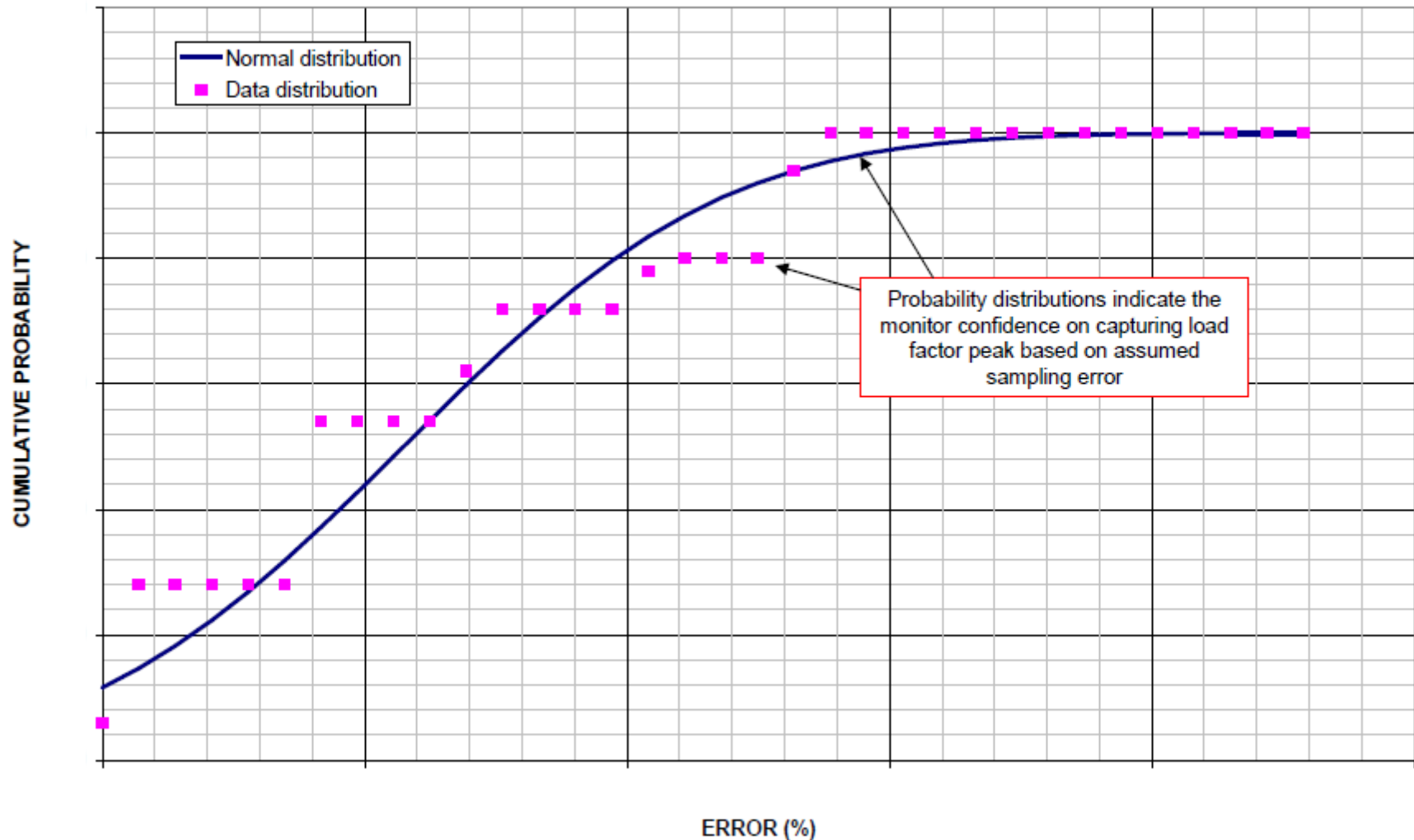


Threshold definition process



Parameters used on threshold definition process

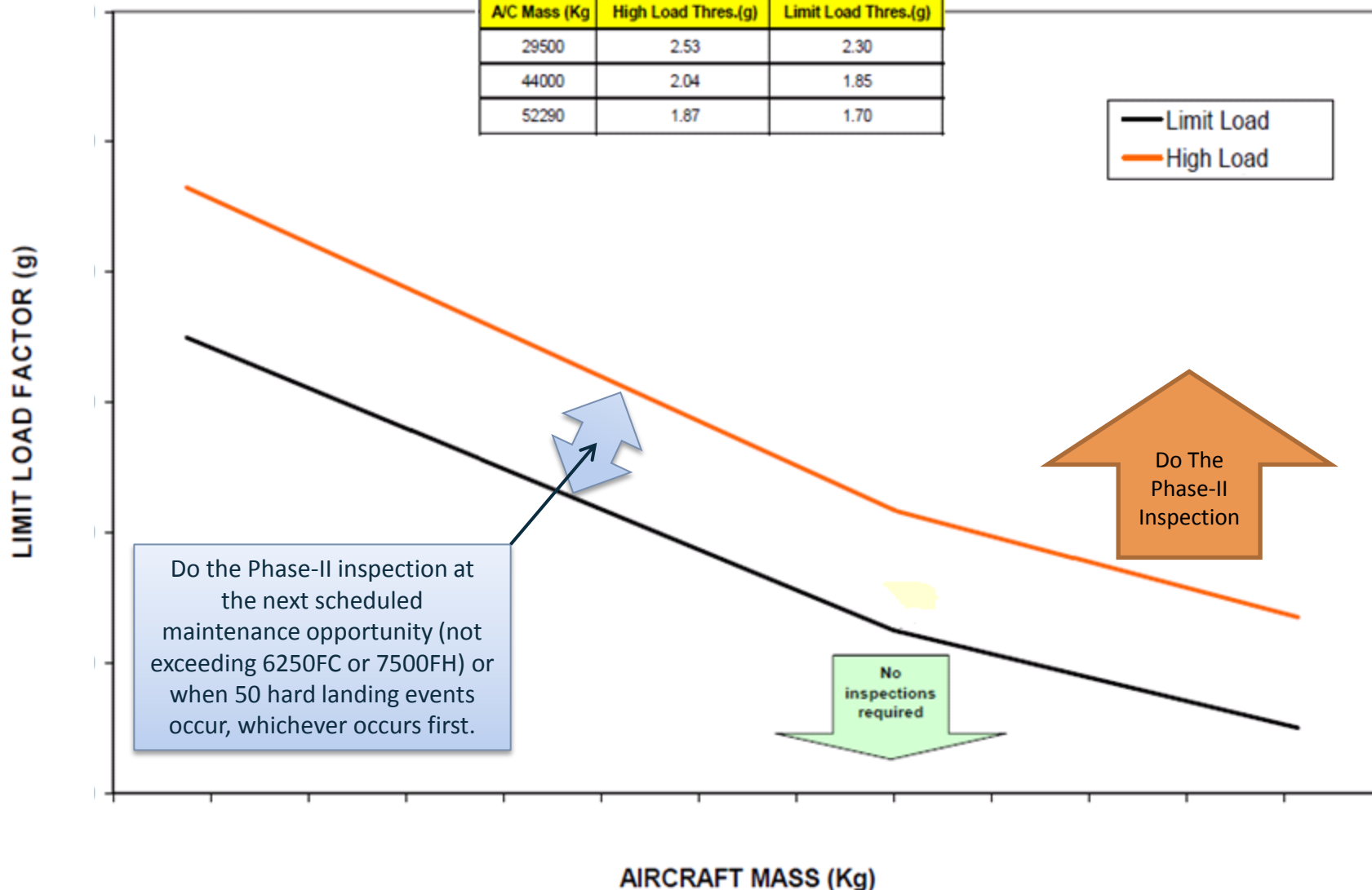
ERROR PROBABILITY DUE TO DVDR LOW SAMPLE RATE



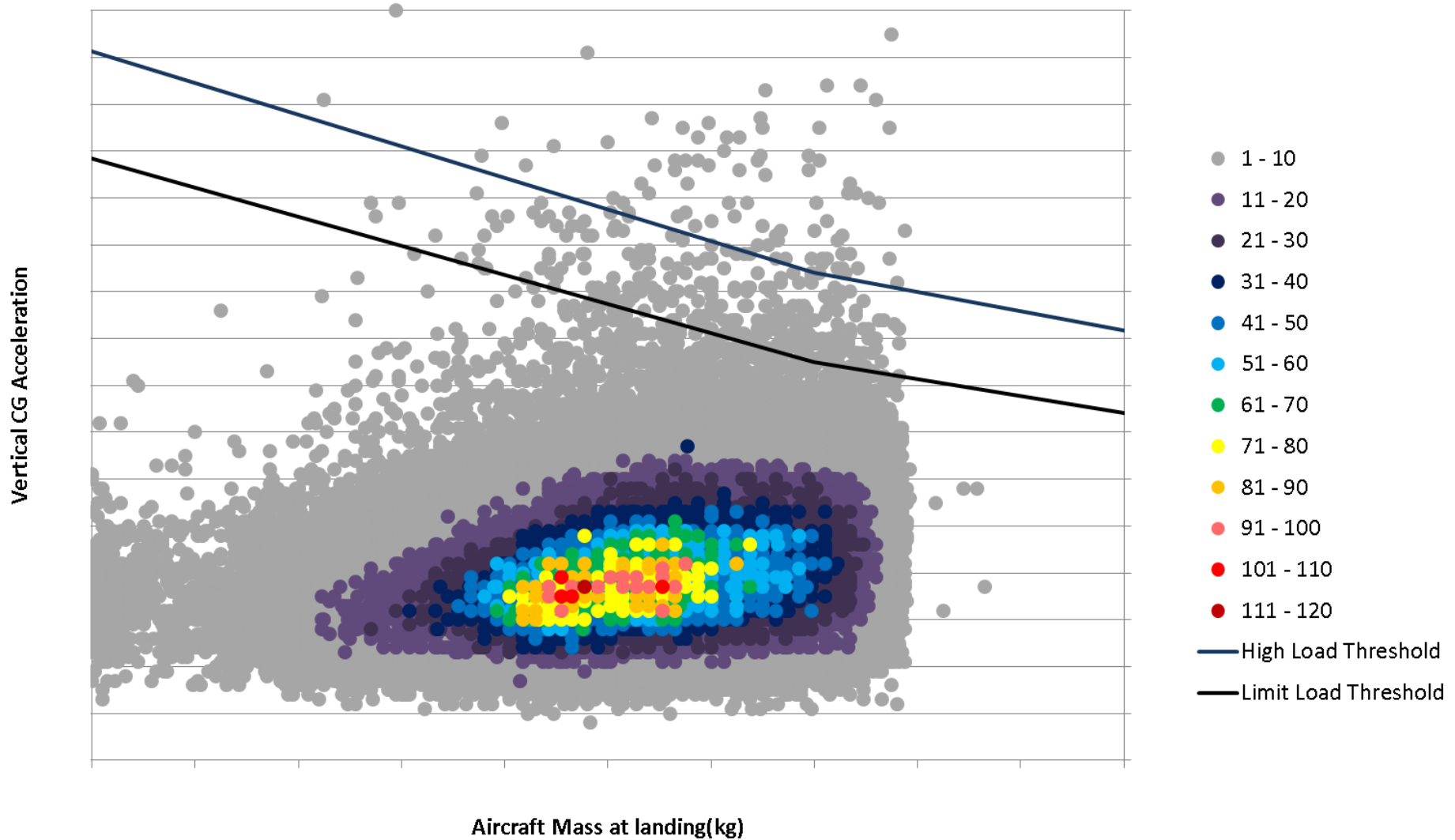
Parameters used on threshold definition process

THRESHOLD COMPARISONS

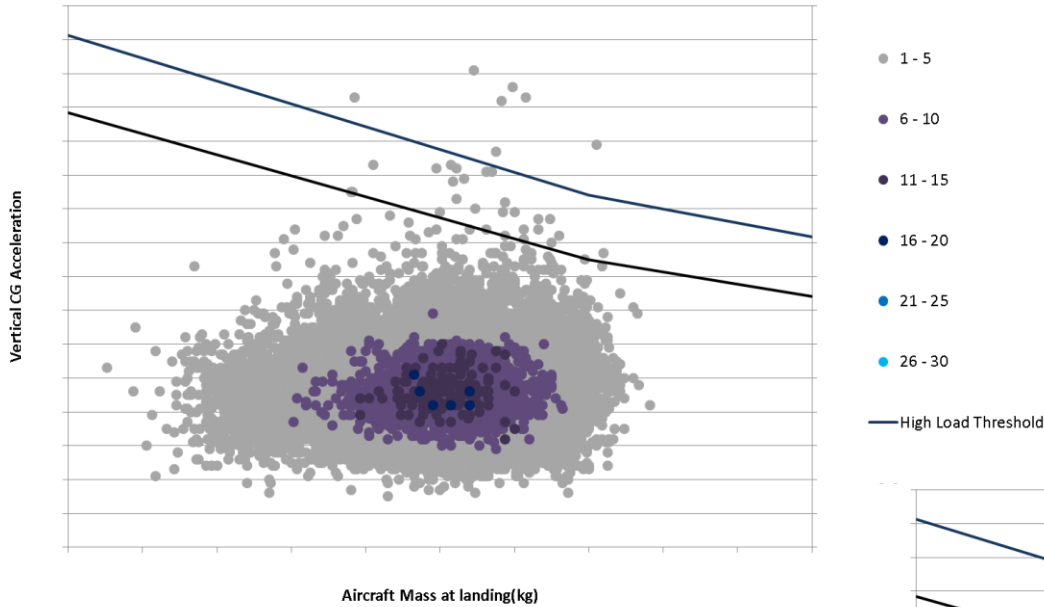
A/C Mass (Kg)	High Load Thres.(g)	Limit Load Thres.(g)
29500	2.53	2.30
44000	2.04	1.85
52290	1.87	1.70



Hard Landing new envelope

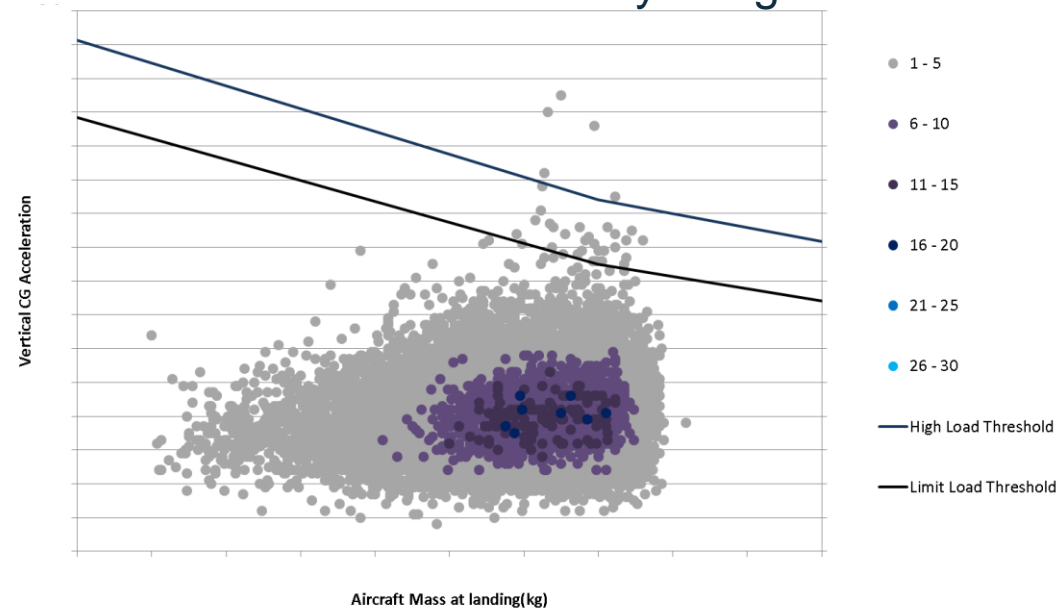


Hard Landing new envelope

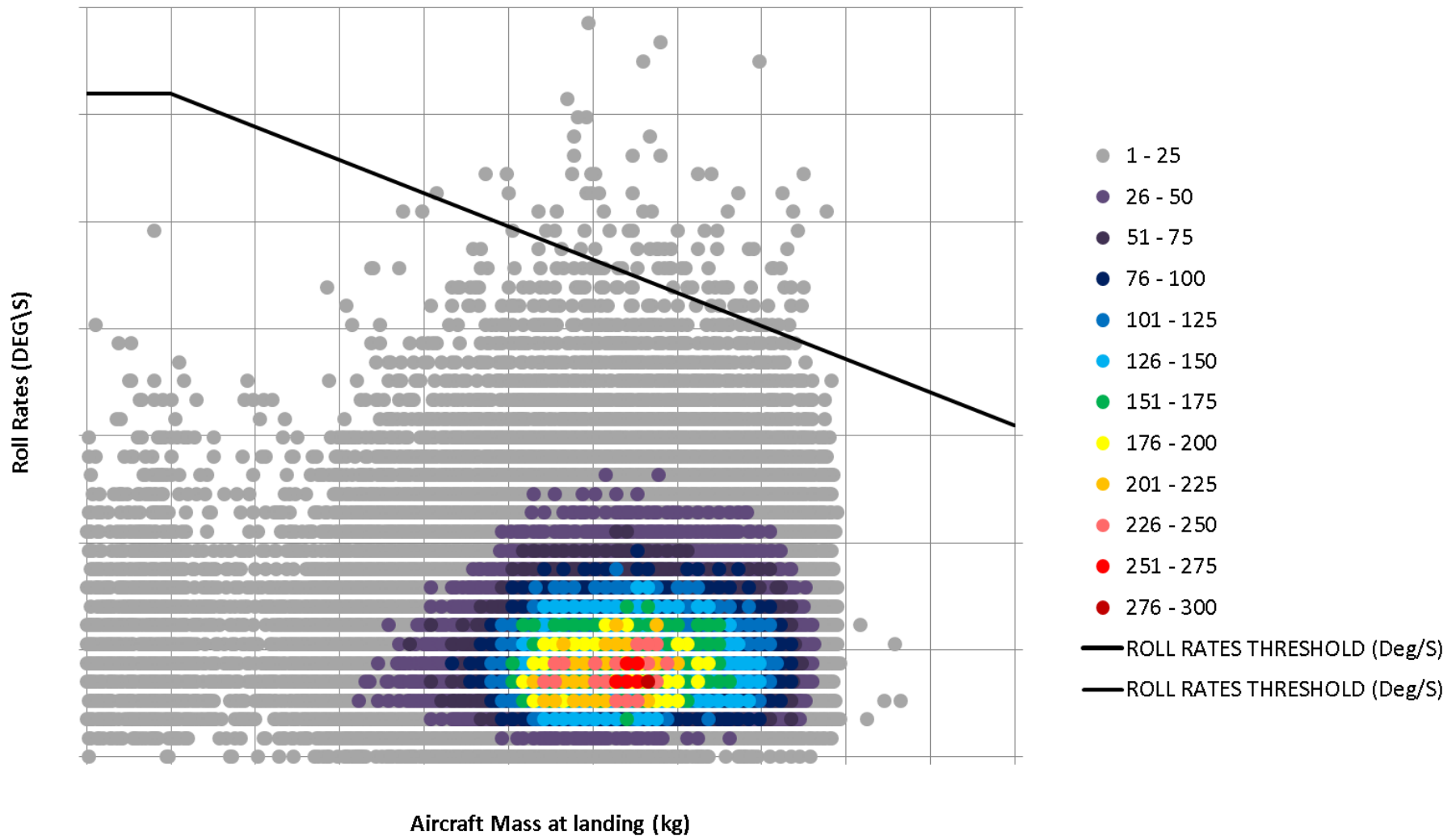


Airport X
Runway Length ~4000 ft

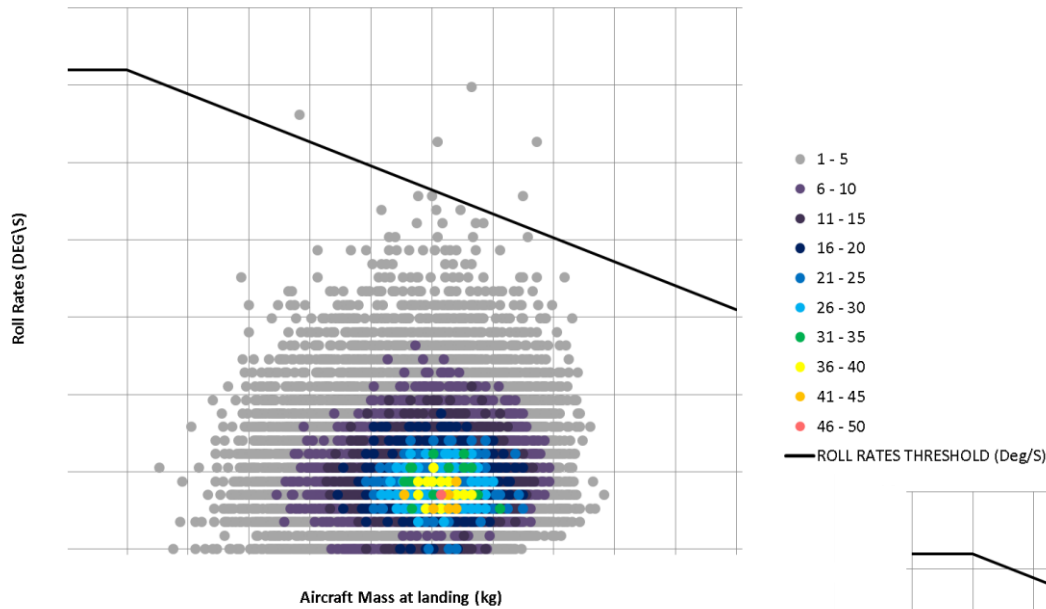
Airport X
Runway Length ~10000 ft



Hard Landing new envelope

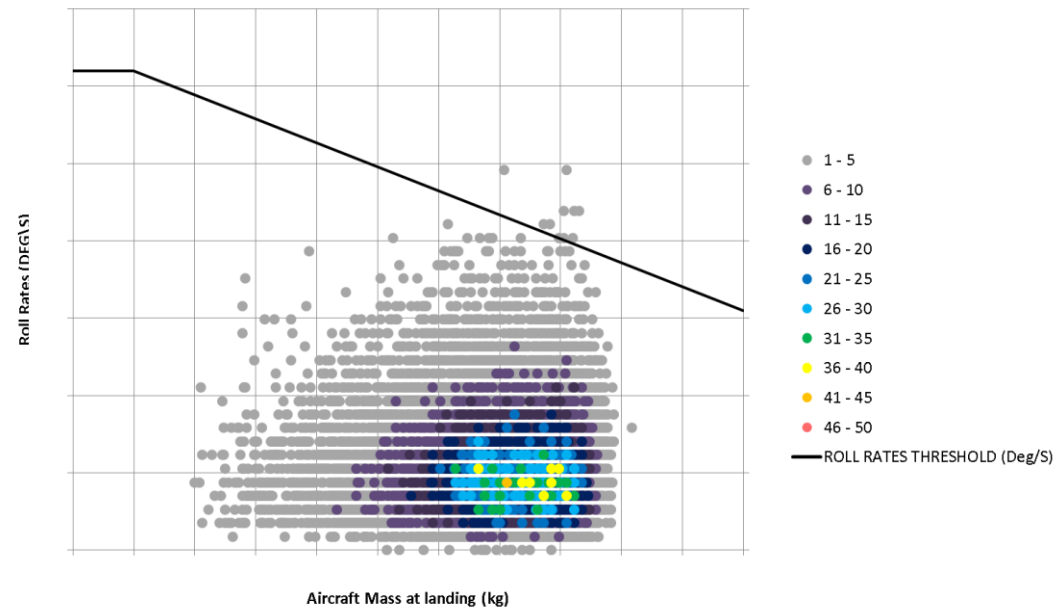


Hard Landing new envelope

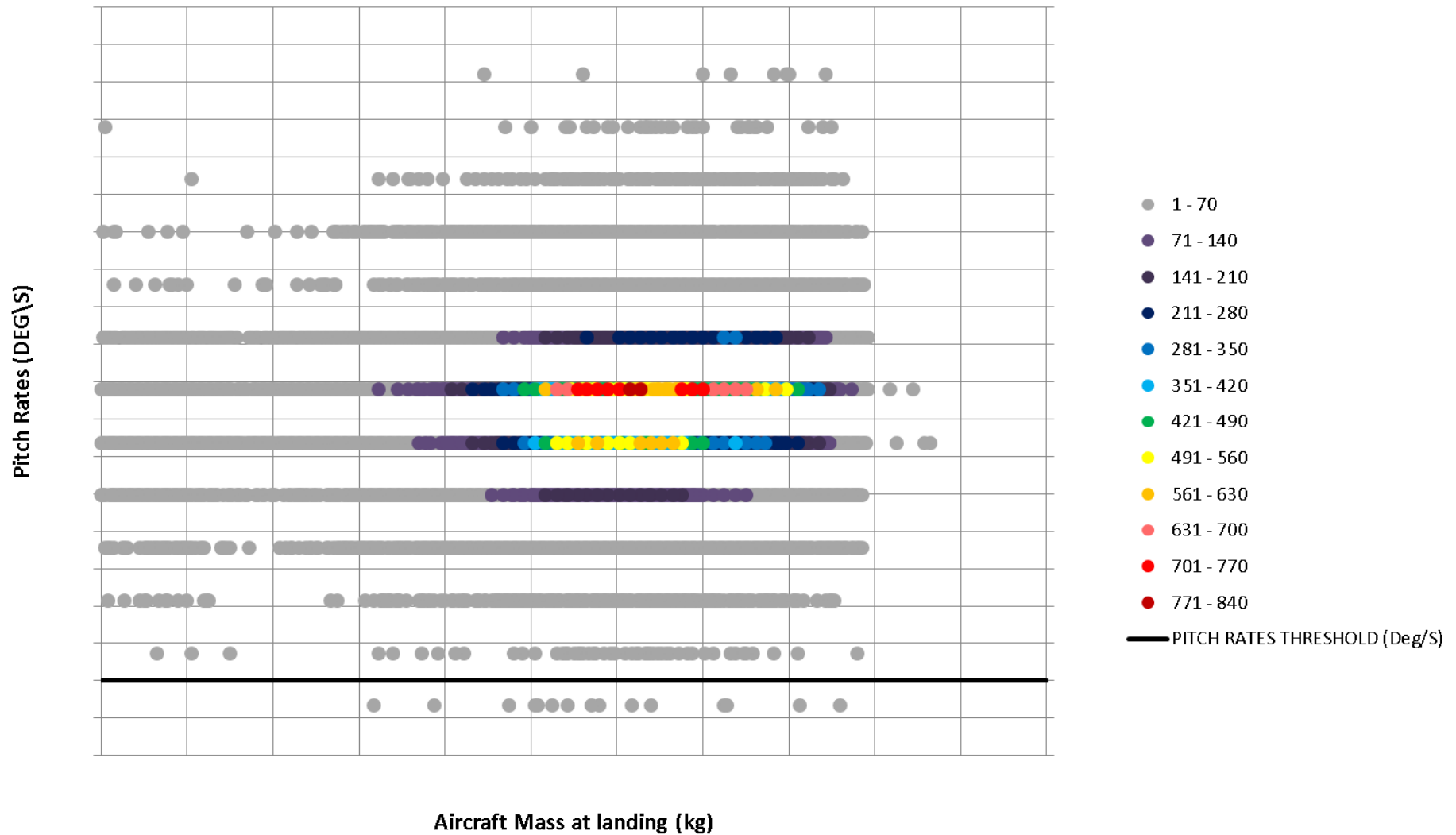


Airport X
Runway Length ~4000 ft

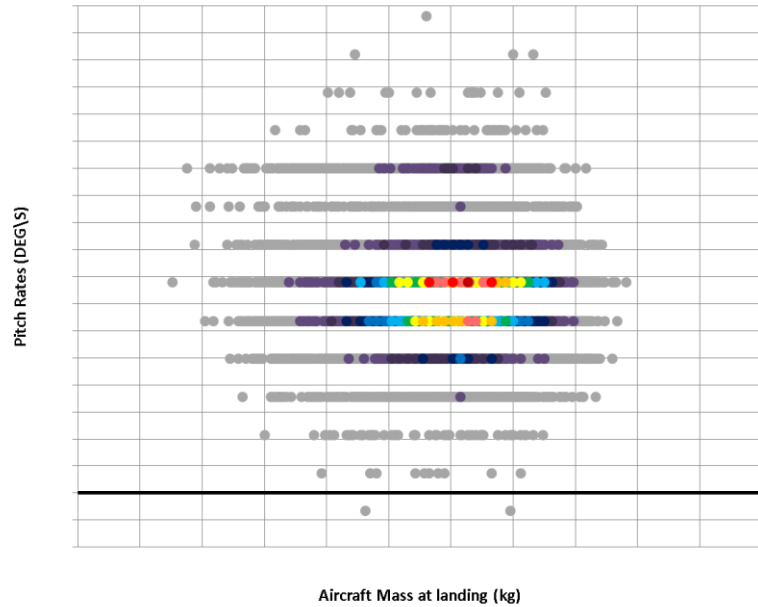
Airport X
Runway Length ~10000 ft



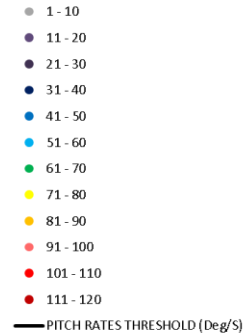
Hard Landing new envelope



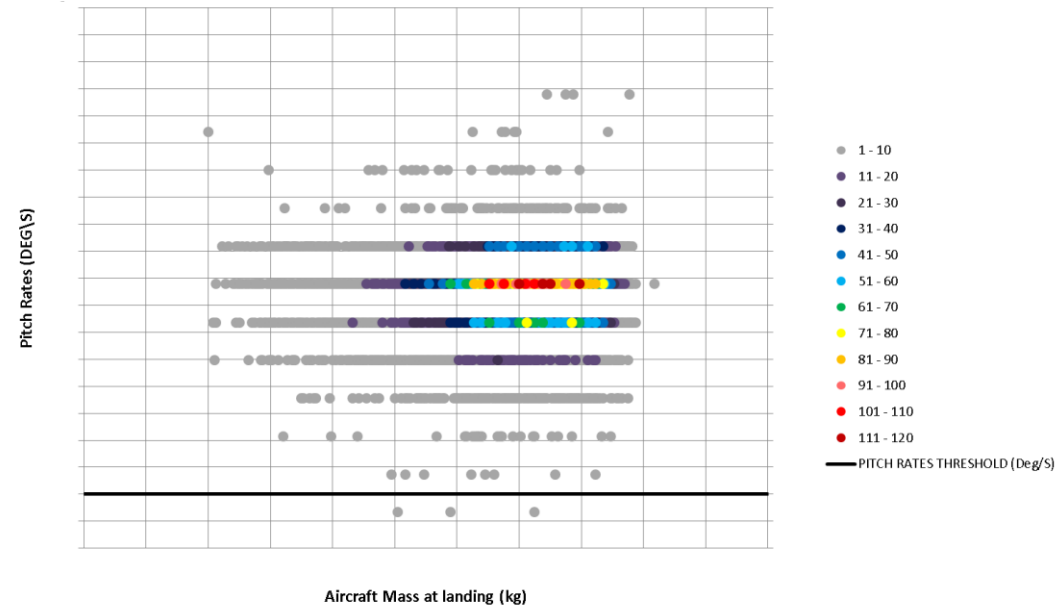
Hard Landing new envelope



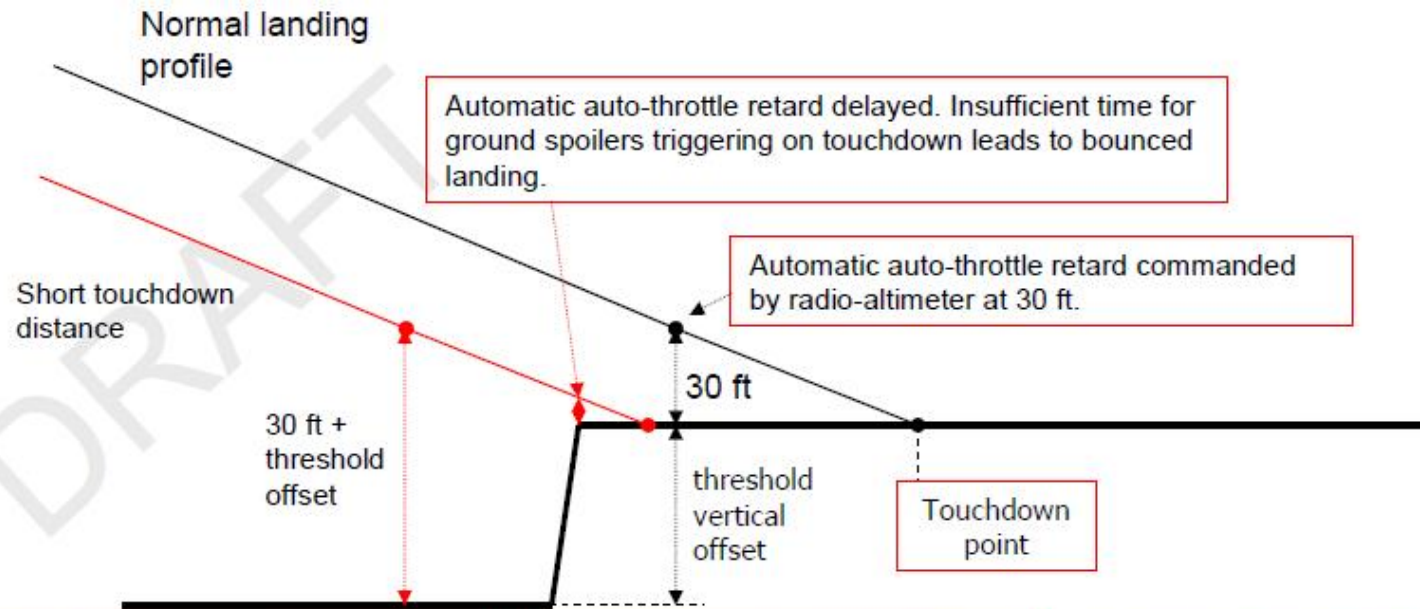
Airport X
Runway Length ~4000 ft



Airport X
Runway Length ~10000 ft



Hard Landing ground spoiler



Threshold offset



Threshold offset



No Threshold offset



Bounced landing Introduction

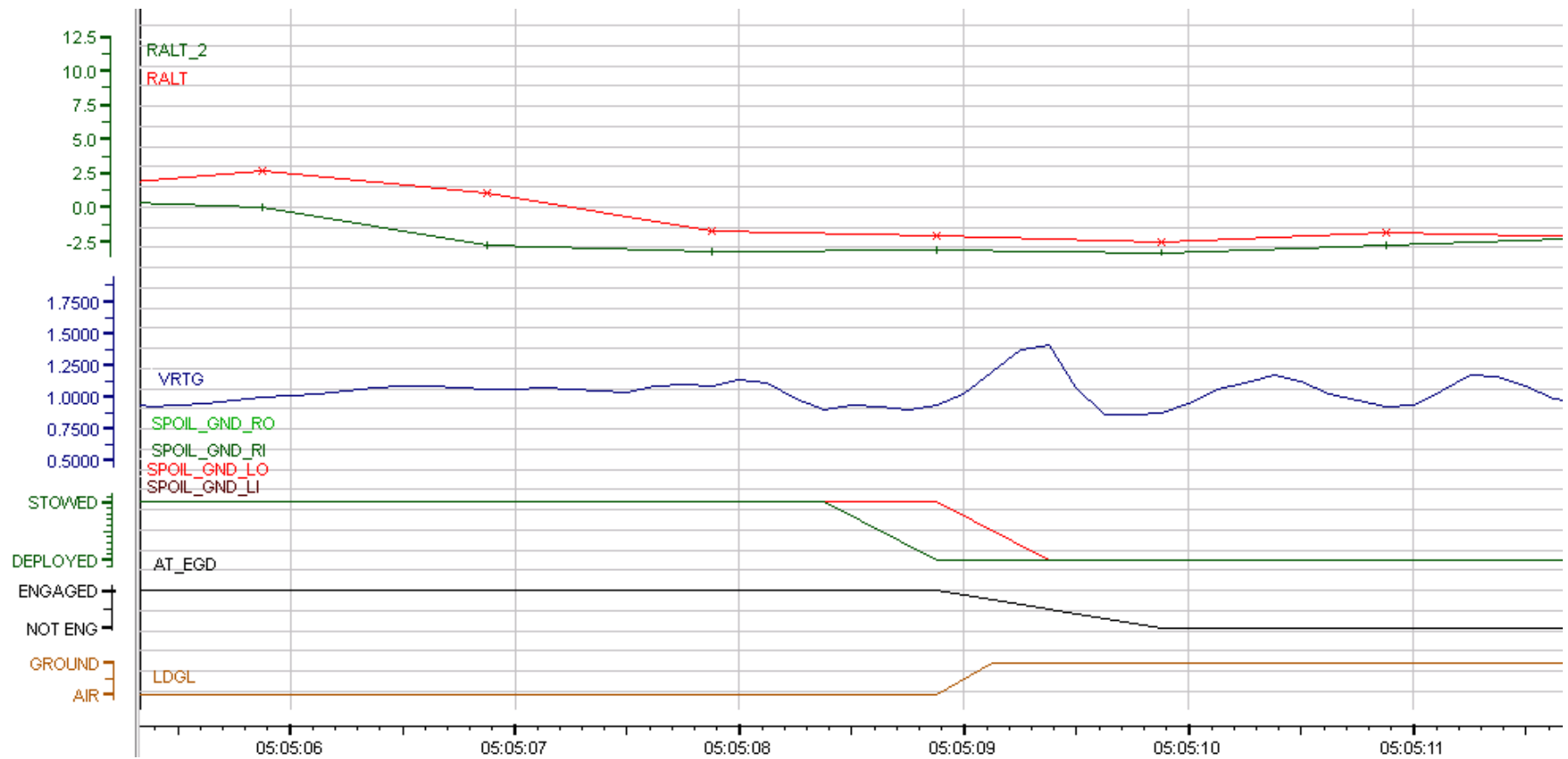
Description: An event that measures excessive G-force at touchdown followed by a second excessive G-force, indicating a bounced.

The FSF ALAR task force said that bounced landings usually result from loss of visual references, excessive airspeed or a power setting on touchdown that prevents automatic extension of ground spoilers.

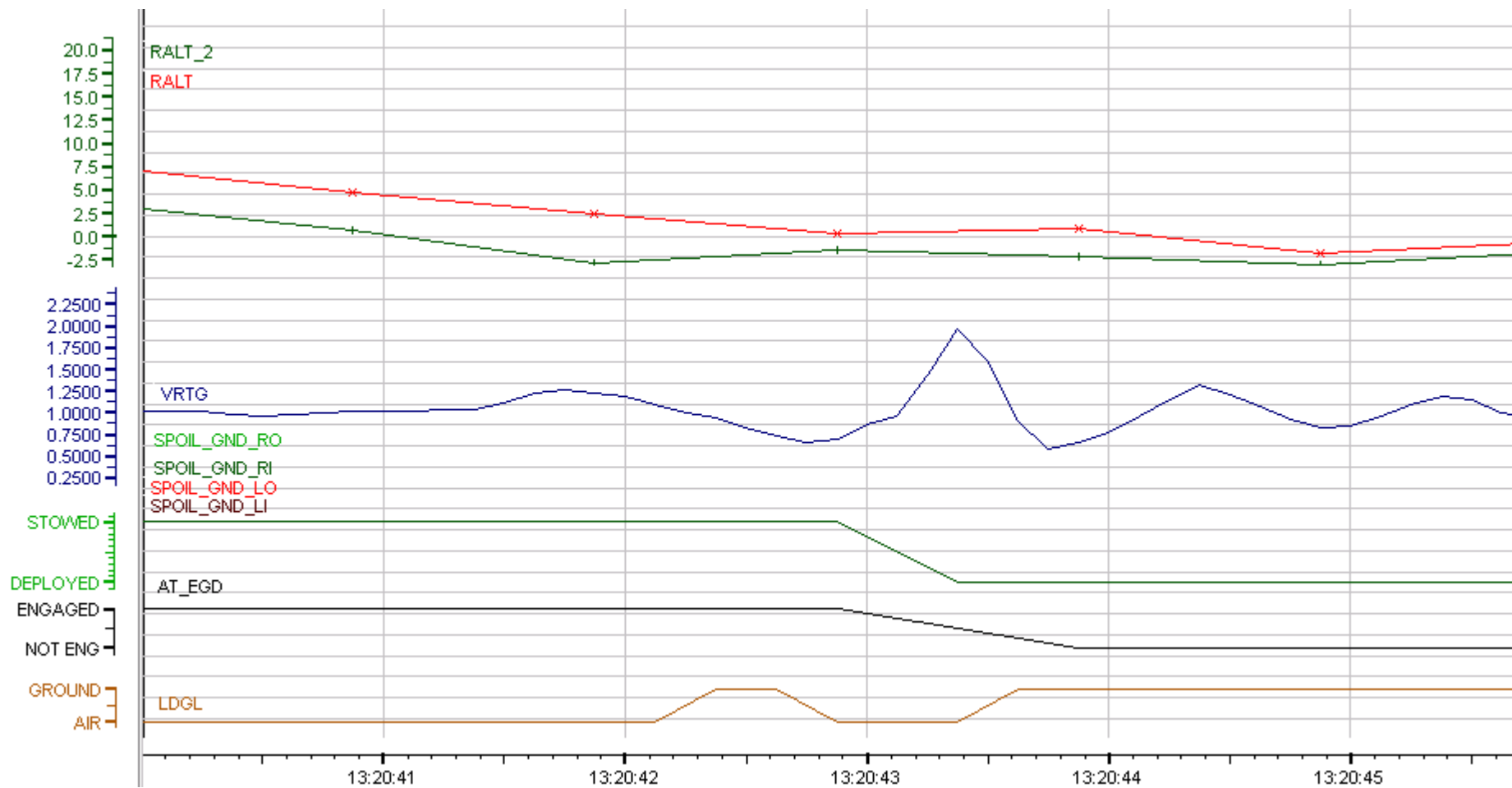


Bounced Landing

- Radar Altimeter is recorded on QAR at 1 Hz.



Bounced Landing



HARD LANDING





ESTAS INFORMAÇÕES SÃO PROPRIEDADE DA EMBRAER E NÃO PODEM SER USADAS OU REPRODUZIDAS SEM AUTORIZAÇÃO POR ESCRITO.